General

The Dominion of Canada, the largest self-governing country in the Commonwealth of Nations is a federal state, established in 1867 by the British North America Act. Discovered by Cabot in 1497, it was formed from the colonies originally settled by the French and British in the 17th century together with lands owned by the Hudson's Bay Company. The Dominion was finally completed by the inclusion of Newfoundland in 1949.

The country now contains the whole of the North American continent N of the border of the United States of America, excluding Alaska which is one of the United States of America but including all of the islands, known as the Canadian Arctic Archipelago, which lie between the Arctic Ocean, on the W, and the median line with Greenland, on the E.

Within the Dominion, there are ten self-governing provinces and three territories administered by the Federal Government, which have a total area of about 3,852,000 square miles. The following describes the Arctic Circle and conditions prevail over Arctic Canada is very sparsely populated.

Of these, three quarters are Inuit (Eskimos) and a very small number are North American Indians, the other native who are found only around the S part of Hudson Bay; most live in small settlements.

The islands of the Canadian Arctic Archipelago, some of which are very large can be divided into three groups, as follows:

1. The Queen Elizabeth Islands, the N group, are separated from the other two groups by Parry Channel and from Greenland by Nares Strait, down the middle of which runs the boundary between Canada and Greenland.
2. The SE group comprises Baffin Island, Bylot Island, and a number of smaller islands.
3. The SW group consists principally of Somerset Island and Prince of Wales Island, situated N of Boothia Peninsula; and, stretching away in a WNW direction from Boothia Isthmus, King William Island, Victoria Island, and Banks Island.

The Northwest Territories evolved from "Rupert's Land and the Northwest Territory" where the Hudson's Bay Company had established trading posts which were acquired by Canada in 1869. Subsequently, all of the extensive lands between Manitoba and British Columbia were added and the Northwest Territories formally organized on the mainland in 1874.

The territories were completed with the transfer to Canada by Great Britain of her sovereignty rights in the Canadian Arctic, although it was not until 1931 that Norway recognized Canada's title to the Sverdrup Islands. The history of the archipelago is largely the history of the search for a Northwest Passage.

The Canadian Arctic regions include all the islands N of the mainland generally referred to as the Canadian Arctic Archi-

pelago and the mainland coast from Point Barrow, Alaska, E to Melville Peninsula and the NW shores of Hudson Bay. The region is roughly triangular in shape, covering approximately 33 per cent of Canada, and the land masses within this vast territory can be divided into three main groups, as follows:

1. **Eastern Block.—**An area covering sea approaches generally made through Davis Strait or Hudson Strait, and along the NW shores of Hudson Bay, Melville Peninsula, Boothia Peninsula, Baffin Island, Bylot Island, Southampton Island, and Somerset Island.
2. **Western Block.—**An area covering sea approaches generally made through the Bering Strait and the Beaufort Sea, or from the Mackenzie River; that includes the mainland coast from the vicinity of Point Barrow, Alaska to the E shores of Peel Sound, Franklin Strait, James Ross Strait, and Rae Strait; and also along the shores of Banks Island, Victoria Island, Prince of Wale Island, and King William Island.
3. **Northern Block.—**Sea route to this area is possible only in the E and S through Smith Sound, Jones Sound, or Lancaster Sound and some of their tributary channels. The passage also consists through the triangle groups N of Parry Channel, collectively known as the Queen Elizabeth Islands.

Buoyage System

The IALA Buoyage System (Region B), with some modifications, has been introduced into Canadian waters. The general direction of buoyage in Canadian waters covered in the arctic is normally S and E. See Chart No. 1 for further IALA Buoyage System information.

A combined lateral and cardinal system is used in Canadian waters. The shape and/or color of the buoy and the color and the flash characteristic of the light indicate the function of the buoy. Mariners are required to use the proper navigation charts with these systems.

Mariners may find port hand buoys painted black or green and safewater buoys black and white or red and white in stripes. Either presentation is to be interpreted as having the same navigational significance.

Mariners are reminded that buoys in the arctic region are liable to disengage from their charted position by ice or inclement weather.

Adjacent to Canadian waters, the West Greenland Buoyage System conforms to Region A of the IALA Buoyage System. All newly-erected and restored beacons that require to be held to port, with an ingoing direction, will be fitted with topmarks in accordance with IALA rules. Hence, port beacons with red can topmarks and beacons with a triangle point down can be expected to be found.

For complete details consult "The Canadian Aids to Navigation System" published by the Canadian Coast Guard and available from Canada Communication Group-Publishing, Supply and Services Canada, Ottawa, Ontario KIA 0S9.

Cautions

Navigation Lights

Mariners are cautioned that colored lights and lights on buoys in this region may be seen as white because of over icing, snow, or hoar frost, and that the visible range of lights can be greatly reduced or disappear for the same reason.

Special Purpose Buoys

Special purpose buoys, used in Canadian waters, do not have lateral or cardinal significance. They may be a variety of shapes of lighted and unlighted buoys. They may display yellow reflecting material. Except for the scientific (data collecting) buoy, all special purpose buoys may display a yellow flashing light.

A hazard buoy marks an area of random hazards such as shoals and rocks. It is white with an orange diamond on opposite sides and with an orange horizontal band above and below the diamond; there is lettering or the hazard symbol inside the diamond. If lighted, the light is flashing yellow, and may display yellow reflecting material.

Currency

The official unit of currency is the Canadian dollar, consisting of 100 cents.

Currents

The Arctic Ocean

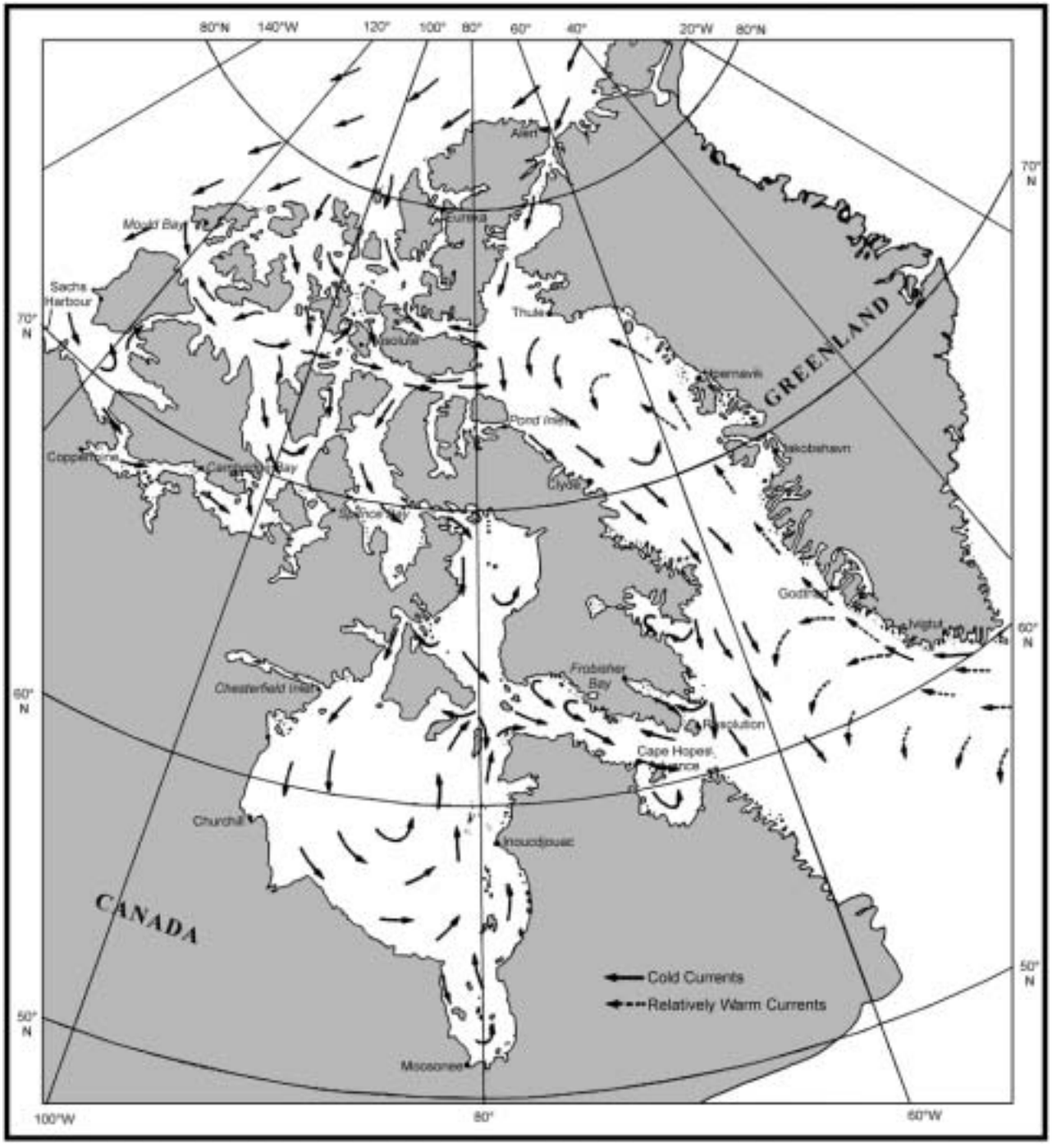
The flow of water off N Greenland and the NW side of the Canadian Arctic Archipelago is determined by a large clockwise circulation centered in the Beaufort Sea. In the N of this area the currents usually set S; elsewhere they set SW. Their mean rate is said to be less than a knot.

Due to the severity of the climate in the Arctic, the tidal and offshore current observations are confined to the short summer season when the greater part becomes ice-free. These observations are just sufficient to indicate that the currents form a pattern, at least in summer. The drift of pack ice and icebergs suggests that the same general pattern may also prevail during the winter.

Water from the Arctic Ocean enters the region through the various channels within and around the Canadian Arctic Archipelago, when it finally emerges into Baffin Bay or Davis Strait. Another main source of water is a relatively warm N current off the W coast of Greenland (West Greenland Current) that eventually rounds the head of Baffin Bay and sets S to SE off the E coast of Baffin Island. As it does so, it is joined by the water emerging from the archipelago. This S to SE current is known as the Canadian Current. To the S of about 61°N it is joined by an outflow from Hudson Strait, the combined flow setting SE off the coast of Labrador where it is known as the Labrador Current.

Since the flow of water is controlled by varying oceanographic and meteorological conditions both within and outside the region, the currents may be expected to show a high degree of variability both in direction and rate. This is particularly so in the channels within the archipelago where they are greatly influenced by the recently prevailing winds. Moreover, the run-off of fresh water from the land in spring and summer greatly affects the currents within and near fiords and in the vicinity of river mouths.

The offshore currents are sometimes influenced by tidal currents to attain considerable rates in some parts of the region.



Generalized Sea Surface Currents

Canadian Arctic Archipelago

In general, the flow of water through the archipelago is from the Arctic Ocean towards Baffin Bay. Where the channels are aligned N to S the currents set S, and where they are orientated W to E the currents set E; there are some exceptions to this general rule.

In Amundsen Gulf, there is a counterclockwise circulation, with water entering the gulf from the Beaufort Sea and leaving by means of a NE current in Prince of Wales Strait and an E set into Dolphin and Union Strait.

A counterclockwise pattern is also said to prevail in Viscount Melville Sound; a branch from this circulation sets N into McDougall Sound.

A SE set into M'Clintock Channel sends a recurved branch N into Franklin Strait and Peel Sound. Although the flow is generally E in Lancaster Sound and Jones Sound, a W current, derived from the Canadian Current, runs along the N side of each sound.

The mean rates of these currents are probably less than a knot except in parts of Nares Strait, where they may sometimes run at 1 knot to 2 knots. The currents in the channels within the archipelago are greatly influenced by the winds; the rate of the current may be temporarily increased or its direction may even be reversed by recently prevailing strong winds.

Geophysical Features

The overall physical features and their pattern of landforms across the vast extent of N Canada and the Arctic Archipelago is defined by tundra and polar deserts.

The entire N coast of the mainland. except at the extreme E end, is backed by an immense terrain with a low surface. The greater part of which is composed of the Canadian Shield. The shield dips towards the N and W, entirely surrounds and underlies a great depression forming Hudson Bay. It then extends N into the archipelago, across most of Baffin Island, terminating in the SE parts of Devon Island and Ellesmere Island.

On the mainland, except around the S part of Hudson Bay which is very low-lying, most of the shield has general elevations of about 450m, but the country is rugged with numerous hills and rocky exposures rising about 30 to 60m above the general level. At the extreme E end of the mainland coast, in N Labrador, the NE rim of the shield has been tilted up to form snow and ice-covered mountains which stretch N, increasing in elevation to over 1,500m along almost the whole of the W shore of Davis Strait and Baffin Bay. Two great waterways break through this mountainous rim to form Hudson Strait, leading to Hudson Bay and Parry Channel, leading to the Arctic Ocean.

The lower W side of the shield, in the vicinity of Amundsen Gulf, and the NW side, where its irregular boundary crosses the S islands of the archipelago, are both gently overlapped by sedimentary rocks, parts of which rise to local hills and plateaux. Farther W, these merge into the Arctic Coastal Plain which borders the shores of the Arctic Ocean as far as the Canada/Alaska boundary, on the mainland, and **Meighen Island** (80˚00'N., 100˚00'W.), on the NW side of the Arctic Archipelago.

The islands of the archipelago, from N of Parry Channel to the N end of Ellesmere Island, are also composed of sedimentary rocks but are of a different nature; they are distinguished by rolling terrain and plateaux along the N side of Parry Channel, giving way to folded plains with piercement domes in the Sverdrup Basin, which occupies the central part, terminating in snow and ice-covered mountains on Axel Heiberg Island and Ellesmere Island in the far N.

The lowlands of the region are dominated by glacial deposits left over from the Ice Age, although, in places, such deposits are totally absent; this is particularly the case on the N islands of the archipelago and around the Mackenzie River where they are replaced by extensive outwash deposits. Many areas are poorly drained, covered with lakes, pools and marshy ground; the latter is found especially around the S part of Hudson Bay. On the E and W sides of the bay, and the E side of Victoria Island in the S part of the archipelago, the glacial drift has been patterned into ridges.

Except around the S part of Hudson Bay and on the S side of the entrance to Hudson Strait in the vicinity of Ungava Bay, the entire region just described is subject to continuous permafrost where the ground is frozen up to 500m below the surface and only thaws in summer to a depth of not more than 1m. Under these conditions, even in places where the soil has not been removed by glaciation, agriculture is impossible and trees seldom grow; however, around the S parts of Hudson Bay and Ungava Bay, particularly at the mouths of rivers, there is a belt of inferior coniferous forest, giving way to smaller, stunted growths. To the N of the treeline, on the mainland, the permafrost plains, called the "Barren Grounds" W of Hudson Bay, are covered with tundra. In the archipelago, most of the islands are bare, the ground locked in by ice for most of the year.

Glaciation is a feature of some coastal areas but, on the mainland, is confined to a small mountainous area at the N end of the Labrador Peninsula. It is also of strikingly small extent in the archipelago where precipitation is too slight to cause a permanent ice-covering of low ground. Glacier ice is significant on Baffin Island, N of Cumberland Sound, as a coastal belt about 60 miles wide, dissected by numerous fiords. It increases N of Parry Channel where a dozen icecaps cover the E part of Devon Island and about 33 per cent of Ellesmere Island and Axel Heiberg Island. Some of these are situated on plateau, while others are highland ice which almost bury underlying mountains. To the W and SW of this main zone of glacier ice there are small icecaps on Meighen Island and Melville Island. Relatively few glaciers reach the sea.

Ice in the ground has produced some unique coastal features. Towards the W end of the N coast of the mainland, in the vicinity of the otherwise low-lying and flat Mackenzie River delta, irregular accumulations have resulted in the formation of large numbers of "ice blisters" with pingos, which are conical or rounded mud hillocks, on them; these are repeated offshore as shoals. In other places, where the ice thaws and produces an uneven settlement of the ground after drainage, lake basins have formed with a characteristic shape depending on the dominant wind direction; examples of these are the countless elongated lakes which back the coasts of the Tuktoyaktuk Peninsula, E of the Mackenzie River delta, and the circular lakes of the Great Plain of the Koukdjuak which bounds the E side of Foxe Basin. Along all of the coasts of the region, extensive glaciation during the Ice Age has produced numerous elevated marine features, principally raised beaches, formed by

The Canadian Arctic—Chartlet No. 1

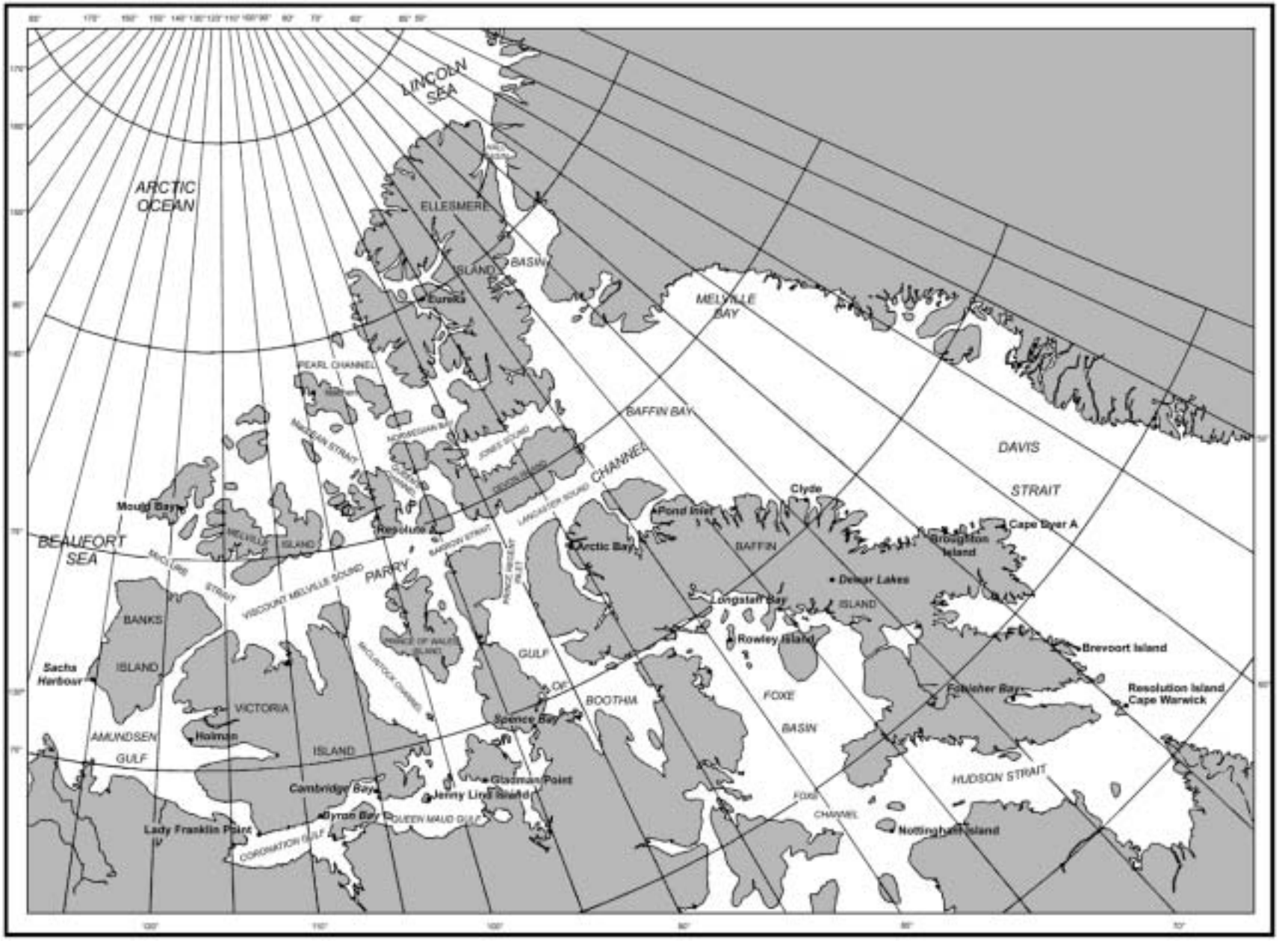


Table of Contents

The Canadian Arctic—Chartlet No. 2

Canada Index

The Canadian Arctic—Chartlet No. 3

the rebound of the earth's crust after removal of the weight of ice upon it and flooding by the sea. This process is still perceptible around Hudson Bay on the E side of which the highest of these features are to be found.

The drainage of that part of the great plateau E of Hudson Bay is divided, the rivers flowing on the one hand to Hudson Bay and Hudson Strait, and on the other to the Atlantic Ocean and Saint Lawrence waterway.

Similarly, the drainage of the "Barren Grounds" is divided between Hudson Bay and the Arctic Ocean. The headwaters of some of these rivers lie in U.S. territory; of these, the largest is Nelson River which is 1,600 miles long from its farthest source in the Rocky Mountains. Along the course of the river there are some important electrical power generating stations and water is also drawn from it for irrigation. Hydro-electric power is also generated on the Churchill River.

The largest and longest of all the rivers is the Mackenzie River which flows into the Arctic Ocean about 110 miles E of the Canada/Alaska boundary; it is navigable by shallow-draft vessels for long distances. Generally, the rivers of the region and most of the streams start to flow after the winter freeze in late May or in June; the flow then increases rapidly to a peak within one or two weeks, decreasing almost as quickly to a low stage for the remainder of the summer. On the mainland, the annual runoff is about half the average of that for the whole country and, in the Arctic Archipelago, about one third of the average.

Eastern Block

The mainland section of the eastern block extends from the vicinity of Chesterfield Inlet north to Bellot Strait and NE to Fury and Hecla Strait. It is mostly an area of rugged Precarnbrian rocks, vast stretches of which are heavily glaciated. Along the low shores of Roes Welcome Sound, between Cape Fullerton and Repulse Bay, this heavy cover of glacial drift has resulted in a smooth and regular coast and has impounded the drainage into a waterlogged pattern of shallow lakes and meandering rivers. Muddy underwater flats extend a considerable distance offshore.

Baffin Island, the largest island in the Canadian Arctic Archipelago, ranks as the second largest island in the northern hemisphere. Its area is 507,451 km^2. Bylot Island, 11,067 km^2 in area, lies within the large bay at Baffin Island's NE corner.

The highland zone along the east coast of Baffin Island extends inland only to about the heads of the major fiords, and south of Cumberland Sound the terrain is upland in character rather than truly mountainous. In Hall and Meta Incognita Peninsulas the land rises toward the east and NE but the greatest elevations seldom exceed 900m. The rugged south and SW coasts of both peninsulas are generally below 300m in height, and are fringed by a maze of reefs, rocks, and islands. The north and NE coasts are, by contrast, bold and precipitous, forming the impressive SW shore of Frobisher Bay and the Davis Strait shore of Hall Peninsula.

The mountainous zone extends NW from Cumberland Sound, with the exception of Barnes Ice Cap, and contains all the major ice fields and glaciers on Baffin and Bylot Islands. The largest and highest of these fields is Penny Ice Cap on Cumberland Peninsula, rising to elevations of about 2,000m in the central area and with heights estimated at just over 2,100m in its SE section.

Between these ice fields, the entire east coast is distinguished by precipitous peaks from 900 to 1,500m high. Some of these rise almost sheer from the sea, and are surrounded by ice fields and glaciers which, although less extensive than those of Bylot Island and Cumberland Peninsula, are nonetheless considerable and impressive. There are also small ice fields in the NE parts of Hall and Meta Incognita Peninsulas.

The area contains two outstanding major features. One is the Barnes Ice Cap, located W of the mountain zone, with streams draining east to the fiords between Clyde and Scott Inlets and W to Foxe Basin N and S of Eqe Bay. The cap rises to about 1,100m and is a relic of the vast ice sheet which formerly covered the entire area. For miles around it is encircled by high moraines and fields of glacial outwash.

The gentle gradient continues offshore for considerable distances giving shallow coastal waters and low featureless coasts. For 10 to 30 miles inland these coasts are bordered by a distinctive belt of waterlogged, marshy country, dotted with numberless shallow circular lakes and drained by a striking pattern of straight parallel currents flowing at right-angles to the coast.

Government

Canada, as a constitutional monarchy, has Queen Elizabeth II as the chief of state. The Queen is represented by the Governor General, a Canadian appointed on the advice of the Canadian Cabinet. The government consists of the Senate and the House of Commons. Senators are appointed by the Governor General and selected on the advice of the Prime Minister. Members of the House are elected, at least once every 5 years by the citizens. The 105 Senators normally serve until they are 75 years of age.

The territories are governed by Commissioners, appointed by the Federal Government, who are assisted by Councils. The majority of these council members are elected by the citizens of the territories. In the Northwest Territories, some members are appointed by the Federal Government, whose responsibilities are exercised by the Minister of the Department of Indian Affairs and Northern Development.

The legal system is based on English common law, except in Quebec where civil law, based on French law, prevails.

The capital is Ottawa.

Holidays

The following are national holidays throughout Canada:

New Year's Day	January 1. (If a Sunday, on the following day.)
Good Friday	Variable
Easter Monday	Variable
Victoria Day and Queen Elizabeth II Day	First Monday preceding May 25
Canada Day	July 1. (If a Sunday, on the following day.)
Labour Day	First Monday in September
Thanksgiving Day	Second Monday in October

Remembrance Day	November 11
December 25	Christmas Day. (If a Sunday, on the following day.)
December 26	Boxing Day

In addition, the Northwest Territories observe a General Holiday, declared by the Commissioner, usually on the first Monday in August. Similarly, the Yukon Territory has a General Holiday on "Discovery Day," usually August 17, to celebrate the discovery of gold in the Klondike.

Ice

Ice (Summer Conditions)

Although the winter pattern remains fairly constant, break-up in summer varies considerably from one year to the other. Certain areas clear regularly every summer, others are almost always severely congested; but the marginal, intervening area is rather extensive and is very important to navigation.

In general, it can be stated that a narrow waterway, or one studded with islets and shoals, is one where melting of the ice depends upon air temperature and solar radiations. An example of this is Coronation Gulf where little ice motion can occur. On the other hand, in a broad, unrestricted waterway such as Parry Channel, wind conditions are by far the most important factor governing the timing and extent of break-up.

The main drift of ice in the Archipelago is to the S and E, but this is the very broadest generalization based on mean winds and average water currents and each channel and inlet has its own peculiarities. A permanent offshore current flows southward through Nares Strait into Baffin Bay where it is joined by a minor drift from Jones Sound, and significantly, from currents in Lancaster Sound and Melville Bay. The resulting Canadian Current on the Baffin Island coast carries ice southward at about 5 miles per day through Davis Strait and along the Labrador coast. In the Arctic Ocean, a general clockwise water current (and ice drift) moves SW along the edge of the Archipelago toward Alaska. Weak branches of this current penetrate through the Queen Elizabeth Islands waterways into Parry Channel and then into Baffin Bay.

Since wind is a major factor influencing the extent of break-up in the broader waterways, it is apparent that favorable conditions in one area can result in very unfavorable conditions in an adjacent waterway if all the neighboring ice is carried into it. Such variations may or may not be temporary. Extensive clearing of ice in one area during one year can lead to difficult ice conditions in the same area the following year. Ice conditions in any one year will be a combination of different portions of such extremes.

Davis Strait and Baffin Bay

This large area is the main gateway to the Eastern Canadian Arctic and as such its ice regime is extremely important to the development and exploitation of that entire region. Water motion is one of several factors which must be considered in studying the ice regime of an area. In general, its importance can be said to vary with current strength. In this particular area the currents not only vary in strength but also in temperature. For instance, there is a relatively warm, N current along the west Greenland coast; a cold, S current along the Baffin Island coast; and a major polynya in Smith Sound at the north end of Baffin Bay. These variables, combined with the physical geography of the surrounding terrain, exert a particularly strong effect on the nature, extent, and severity of the ice regime.

The warm current flowing N along the Greenland coast, although very weak, slows the ice formation in eastern Davis Strait; this results in earlier break-up along the coast from Disko to Kap York and provides an early access route into the "North Water" of Smith Sound and NW Baffin Bay. At the same time the cold Canadian Current flowing southward along the Baffin Island coast is relatively strong and results in early ice formation, delayed break-up, and an extension of ice-covered waters far beyond the limits of Davis Strait.

The polynya in Smith Sound, which is commonly referred to as the "North Water," is maintained by N winds, water currents, and an ice bridge in the northern part of the sound. Vertical mixing of the warm and cold waters may also play a part. It recurs every year and is always present, although during calm periods in mid-winter it may be briefly covered by new or young ice. Because it occurs every year, it is called a recurring polynya.

As soon as air temperatures begin to rise in spring, this polynya expands southward and soon extends into the major area of Baffin Bay.

An opening in the ice at this time of year is important for various reasons. It is a source of waves which assist in the break-up of neighboring ice, and it provides an area into which the adjoining ice can disperse where it will melt more rapidly. Of even greater importance is the heat flow into the water which occurs because clear skies are common during the Arctic spring and days are long. A water surface absorbs most of the solar radiation reaching it, whereas an ice surface reflects most of this energy. A polynya is a heat source, and a focus for the disintegration of ice.

Freeze-up in Baffin Bay is a lengthy process beginning in mid-September in the NW sections. The growing ice cover spreads southward across the approaches to Jones Sound during the last week of September, across the approaches to Lancaster Sound during the second week of October, and along the Baffin Island coast across the approaches to Frobisher Bay by the second week of November. The first permanent ice in Melville Bay usually develops during the second week of October. A rapid seaward expansion of the ice cover occurs during the latter half of October and ice spreads to all but the west coast of Greenland by the end of November. This lead along the Greenland coast gradually retreats southward to Upernavik in December and as far as Egedesminde by mid January. Only brief intrusions of ice driven by onshore winds occur along the Greenland coast from Egedesminde to Godthaab, though some fast ice does form in bays, fiords, and inlets.

Although ice from East Greenland (commonly called "storis") rounds Cape Farewell each winter, it rarely moves further north than 62°N and reaches Godthaab only once in 20 to 30 years. The maximum extent of this ice occurs in late spring after the Baffin Bay ice has begun to retreat and the two areas of ice never mingle.

The undisturbed ice cover in Baffin Bay can grow to 120 to 200cm during the winter in the N portions and 75 to 150cm in

the S, but the general southward drift of the offshore ice exerts its influence making the floes somewhat thinner off Lancaster Sound and thicker off Cape Dyer. Distortion of the floes in the form of ridges and hummocks results from the varying winter winds in the area.

Fast ice becomes well developed in the Kap York Upernavik sector of Greenland, often reaching 15 to 20 miles wide in Melville Bay. Despite the absence of offshore islands similar growth also occurs on the Baffin Island coast because of the frequency of winds having an onshore component. The width of this shore-fast ice varies mainly between 8 and 19 miles from Pond Inlet southward along the coast to Cape Dyer, except in Home Bay where it expands to 32 miles in places. Between Cape Dyer and Cape Mercy the shore-fast ice is much narrower.

In spring the "North Water" begins to expand southward toward Kap York and Bylot Island as the rate of formation of new ice decreases. At the same time, the warm current on the Greenland coast begins to form a lead northward beyond Disko. These two open water areas join during the last week of July and for the remainder of the summer the ice is exposed to wave action on three sides. While this is developing, it is normal to find a separation of the Baffin Bay and Davis Strait ice beginning at Cape Dyer where tidal motion is strong.

During July and August, the ice usually melts more quickly on the north Baffin Island coast than it does in the center of the bay, because its retreat is aided by water motion and the fact that the water coming from the north has been warmed by the sun for several months. The remaining "Middle Ice" extends from Cape Dyer and Home Bay northward to about 73˚30'N in early August, and is reduced to numerous offshore patches by the end of the month. The ice in the Cape Mercy/Cape Dyer area also melts gradually during this period with very little southward drift past Cape Mercy.

Complete clearing of Baffin Bay does not occur every year, but the floes remaining in late September are easily dispersed by autumn storms, and are nearly always carried out of the bay before the growing ice attains appreciable thickness. Also late in the season, intrusions of old ice can occur through Smith Sound into Baffin Bay. Patches of this ice can be carried into the Devon and Bylot Islands area in October to become a constituent of the growing ice. Some old ice has also been known to enter Baffin Bay from Lancaster Sound. The total area of such intrusions would amount to only a small percentage of the total ice cover.

Another feature of Baffin Bay is that it is the birth place for thousands of icebergs produced by the Greenland and Ellesmere Island glaciers.

Nares Strait

This northernmost waterway connecting Baffin Bay to the Arctic Ocean contains some of the heaviest ice in the entire Archipelago. There is a general clockwise drift of ice in the North American sector of the Arctic Ocean, and as a consequence, onshore pressure is common along the N coasts of Greenland and Ellesmere Island. A cold water current carries the severely deformed ice of the Lincoln Sea into Nares Strait whenever the ice is free to move, and often results in a drift of old ice into Baffin Bay in the autumn.

A recurring polynya, the "North Water," occupies the S end of Nares Strait, but because of the current and mean winds, its influence is felt mainly in Baffin Bay. The N edge of this polynya lies in the narrowest portion of Smith Sound at about 78˚30'N. From Kane Basin to the Lincoln Sea, the strait is covered in winter with a solid, non-moving layer of predominantly old ice, cemented together by locally formed first-year ice.

When melting begins in mid-June there is little change other than puddling for about one month, but limited areas of open water can appear at the head of some bays along the coast of Ellesmere Island.

Break-up develops in mid-July as the first-year floes become rotten and permit the old floes to drift about in response to winds and currents. The speed of the current changes as the waterway varies in width, resulting in specific areas where dispersed ice is most common, Kennedy Channel being one such area, and others where congested conditions develop easily. Nevertheless, wind drift is the important factor which modified ice motion, caused initially by the water current, can clear or congest specific areas, create leads, or stop southward transport of ice completely. The ice remains variable and mobile until freeze-up but differs from the other channels in its higher proportion of old Ice.

Freeze-up progresses slowly from early September, because autumn storms are common in Baffin Bay resulting in northerly winds in Nares Strait which thus prolong ice motion. Consolidation of the ice cover occurs most frequently during January.

Humboldt Gletscher, on the east side of Kane Basin, is an important source of icebergs which tend to collect in major groups awaiting favorable conditions before starting their southward journey through Smith Sound. Ice islands or their fragments can be carried into the waterway from the Arctic Ocean and have been known to temporarily block all ice motion by becoming lodged against the islands in Kennedy Channel.

Ice (Winter Conditions)

Sea ice presents a severe hazard to shipping over the region by late winter (March/April) when all but the extreme SE part is usually ice-covered. However, the greater part becomes ice-free by late summer (August/September) at which time the ice is confined to the W and N parts of the archipelago and to the oceanic area farther N. Changes in ice cover from one year to another in the same month are also considerable, especially in the channels within the archipelago.

Due to the relative narrowness of the channels, the ice becomes fast over the greater part of the Canadian Arctic Archipelago each winter; the exceptions are the Gulf of Boothia and most of Lancaster Sound.

Over the remainder of the region, outside the archipelago, the fast ice is confined to a relatively narrow strip along most coasts. The outer edge of the fast ice in the region cannot be generally related to any given depth contour, as it can in other regions where heavily-ridged old ice floes ground in relatively shallow water forming anchor points for the ice to become fast.

Although this process probably accounts for the position of the fast ice edge to the N and NW of the archipelago, it clearly cannot apply to the remainder of the pack ice zone where the ice normally melts each summer. In these latter areas the fast ice edge is usually located close inshore except where there are

off-lying islands, as on the E side of Hudson Bay; even here the edge does not always extend from the mainland shore to the islands.

In parts of Baffin Bay, notably Home Bay and Melville Bugt, the fast ice edge is usually located over considerable depths, sometimes 200m or more, away from any islands. In these areas icebergs grounded on banks far offshore probably account for this abnormality.

In some areas the fast ice edge does not occupy the same approximate position every year. For example, fast ice sometimes covers Lancaster Sound and occasionally the ice in Amundsen Gulf does not become fast. This variability has a considerable effect on the time of break-up at both ends of the Northwest Passage. In the former case break-up may be delayed for almost two months; whereas, break-up may occur about 2 months earlier than normal. The fast ice edge in M'Clure Strait is sometimes found at about 119˚W; whereas, normally it occurs at about 125˚W.

The position of the fast ice edge varies, as its location probably depends on the winds during the early winter at the initial stages of ice development. It is thought that light winds during this period will allow the ice to become fast over the maximum area; whereas, strong winds will tend to delay or even prevent the process.

Hudson Bay and Hudson Strait

Although both areas are frozen over each winter, the ice always melts completely in summer, usually for a period of about 3 months. Break-up does not normally begin until late April when leads appear on the NW side of Hudson Bay and the N side of Hudson Strait, although strong offshore winds may temporarily open up leads off any coast in earlier months. The process of break-up is slow and by late June the greater parts of both areas are still ice-covered. Even thought long stretches of the coastline in Hudson Bay are usually ice-free at this time, the approaches to the bay are obstructed by close pack ice.

Open water appears on both the W and E sides of Hudson Bay at the end of June.

The greater part of melting in both the bay and the strait occur in July, and by the end of this month there is usually easy access through Hudson Strait to any port in Hudson Bay; both areas normally become completely ice-free by mid-August. In a bad season an easy passage through Hudson Strait may not be achieved until the end of August due to pack ice from Foxe Basin being driven across the W end of the strait by N winds. In such a season final clearance in Hudson Bay does not occur until early September.

The onset of the new ice season usually begins in early November in the NW part of Hudson Bay. By the end of that month the N part of the bay and the W part of the strait are usually ice-covered.

Davis Strait and Baffin Bay

The sea ice in Davis Strait is derived from two different sources. The greater part, known locally in Greenland as the "West Ice," is formed within Baffin Bay and Davis Strait. The remainder of the ice, known as the "East Ice" or "Storis" is derived from off the E coast of Greenland; this ice rounds Kap Farvel under the influence of the current to affect parts of the area off the SW coast of Greenland. The "West Ice" usually reaches its greatest extent in March and April when the whole area, apart from the SE approaches to the Davis Strait, is ice-covered. The ice edge lies much farther S on the W side of Davis Strait than it does on the E. This is due to the disposition of the cold and warm currents in the area. At this time of greatest extent (March/April) the maximum limit, which is associated with persistent NW winds, lies a considerable distance from the mean, but the minimum limit, occurring when SE winds prevail, lies only about 50 to 100 miles NW from the mean. This restriction on the minimum limit is probably due to the cold, ice-bearing Canadian Current.

Small openings sometimes occur off the E coast of Baffin Island in March and April, mainly due to strong offshore winds, while a small open water area, or polynya, usually forms at the head of Baffin Bay at the end of April, although it may appear temporarily in any earlier month. This polynya, known as the "North Water," forms at the flaw between the fast ice in Smith Sound and the pack ice in Baffin Bay. Strong ENE winds, not uncommon in winter, drive the pack ice away from the Greenland coast towards Ellesmere Island, where it is carried S by the current. A lull in these winds allows the "North Water" to freeze again until a further strengthening of the winds repeats the clearance process.

During the months of May to July, the ice edge in Davis Strait retreats rapidly N and more slowly W, then trends to N to S orientation in June and July, forming a wide lead off the Greenland coast. This unusual configuration can only be attributed to the pattern of the currents in this area. However, the reduction in ice cover is not solely due to the NW retreat of the ice edge in Davis Strait. Ironically, melting also occurs from the N. As air temperatures rise in late winter, the re-freezing of the "North Water" proceeds more slowly and as a result stretching begins to increase until, by late July there is usually a vast area of open water in the NW part of Baffin Bay. The pack ice between this open water and the wide lead off the coast of W Greenland is often referred to as the "Middle Pack." The "North Water" usually links up early in August with the open water farther S. A considerable degree of melting occurs during August and early September so that by mid-September, the whole area is usually ice-free. In a light ice season, Baffin Bay may become ice-free by late August, but in a severe season an area of ice off the E coast of Baffin Island may persist throughout the summer.

Although new freezing usually begins in the N in September, only the N part of Baffin Bay is ice-covered at the end of October. During November the ice edge advances SE at its maximum rate; thereafter the rate of advance slows up until the ice edge reaches its greatest SE extent in March and April. In a severe, early winter season, associated with NW winds and the persistence of some ice throughout the summer, pack ice may cover most of Baffin Bay and a substantial part of Davis Strait by the end of October, but in a light ice season, usually associated with SE winds, this position may not be reached until about mid-November.

The Storis or the East Ice usually rounds Kap Farvel during April, although it may do so by late November in a severe ice year, and recedes E of this cape early in August. It reaches its greatest NW extent in April and May, when the NW limit normally lies about 150 miles from Kap Farvel. The orientation of this tongue of ice varies from year to year. In some years it may point towards W and in others more towards

NW. The Storis is usually widest in the SE where its width is normally 60 to 70 miles, and there is normally a lead along the coast extending as far SE as Frederiksdal. In a severe year the Storis may extend N to about 65˚N off the W coast of Greenland in May, June and July, but there its concentration is usually less than 5/10. Again there is normally a wide lead along the coast, except in the far SE, but onshore winds may close this lead from time to time. The minimum limit from April to August lies E of Kap Farvel. However, it would be wise to assume that even during a light season some ice penetrates W of Kap Farvel during these months, although it might be only in the form of a narrow tongue lying parallel to the coast.

The maximum limit at the end of March appears to link the "West Ice" with the Storis. This is a consequence of combining the worst conditions from different years. In any one severe ice season these two ice fields are unlikely to link together since that result in maximum conditions for the "West Ice," mainly NW winds, simultaneously produce minimum conditions for the Storis and vice versa.

Ice (Canadian Arctic Waters)

The severity of the Canadian Arctic winter is such that even unusual year to year variations in weather produce little change in the total ice cover. Thus the yearly variations are measured by means of the thickness of the ice rather than by its extent or nature. But even here, the differences from season to season are of minor importance. It is generally not significantly easier for a vessel to penetrate 180cm of ice than 200cm. Yet in order to reduce ice thicknesses from 200 to 180cm, daily temperatures would have to range about 9˚C above normal for three entire months which is an appreciable variation. Therefore, the following description of winter ice conditions can be considered relatively accurate for most winters, regardless of weather variations.

In general, ice begins to form in early September. The dates vary from one year to another and one to another location, with the earliest formation occurring adjacent to old ice, unmelted floes, and in the northernmost shallow areas. Initial ice is very weak and easily broken up, but as temperatures continue to fall in September and October, it soon consolidates into a solid non-moving sheet over the most of the channels. First year ice grows to 45 to 90cm by the end of November, 90 to 150cm by the end of January, and to 120 to 200cm by the end of March. Maximum thicknesses occurring in mid- May reach the 150 to 225cm range in most areas.

Most of the channels in the Archipelago are solid and non-moving ice during the winter, except for Lancaster Sound and portions of Prince Regent Inlet and Gulf of Boothia where the ice is in restricted motion. Tides, currents, and wind in combination keep the ice in motion throughout the Arctic Ocean, Baffin Bay, Davis Strait, and Foxe Basin in the winter. In these areas flaw leads, pressure ridges, and slightly dispersed ice can develop at any time depending upon the wind regime. A major polynya, the North Water, is always present in Smith Sound as a result of ice motion. Limited polynyas can also develop as a result of tidal currents in Hell Gate and Penny Strait, but these have little relation to the overall winter regime. An extensive polynya, called the "Cape Bathurst Polynya," develops in most years in Amundsen Gulf in spring as a result of the seasonal wind direction. It does not form every year, however, and its location can vary significantly. It is not usually present during winter months.

Ice Convoys

When ice conditions are severe, masters of ships may be requested to form their ships into convoy for escort by an icebreaker or icebreakers.

Masters of ships being escorted should provide the master of the icebreaker with the following information to give an approximate assessment of their vessels' capabilities:

1. Tonnage (gross and net).
2. Open water speed.
3. Ice class, if any, and classification society.
4. Drafts forward and aft.
5. Number of propellers and rudders.
6. Shaft horsepower.
7. Propulsion plant, whether diesel or turbine, etc., and astern power expressed as a percentage of full ahead power.
8. Radiotelephone working frequencies.

Communication in Ice Convoys

It is essential that all vessels be equipped with radiotelephone transmitting and receiving facilities on the bridge. They should be capable of working medium frequencies 2134 kHz, 2237 kHz, 2738 kHz, 2182 kHz, and very high frequencies 156.8 MHz and 156.3 MHz.

All ships under icebreaker escort should maintain a continuous radiotelephone watch on the bridge and all advice originating from the icebreaker should be acted upon immediately.

For further details consult the Canadian Coast Guard publication "Ice Navigation in Canadian Waters."

Ice Reconnaissance

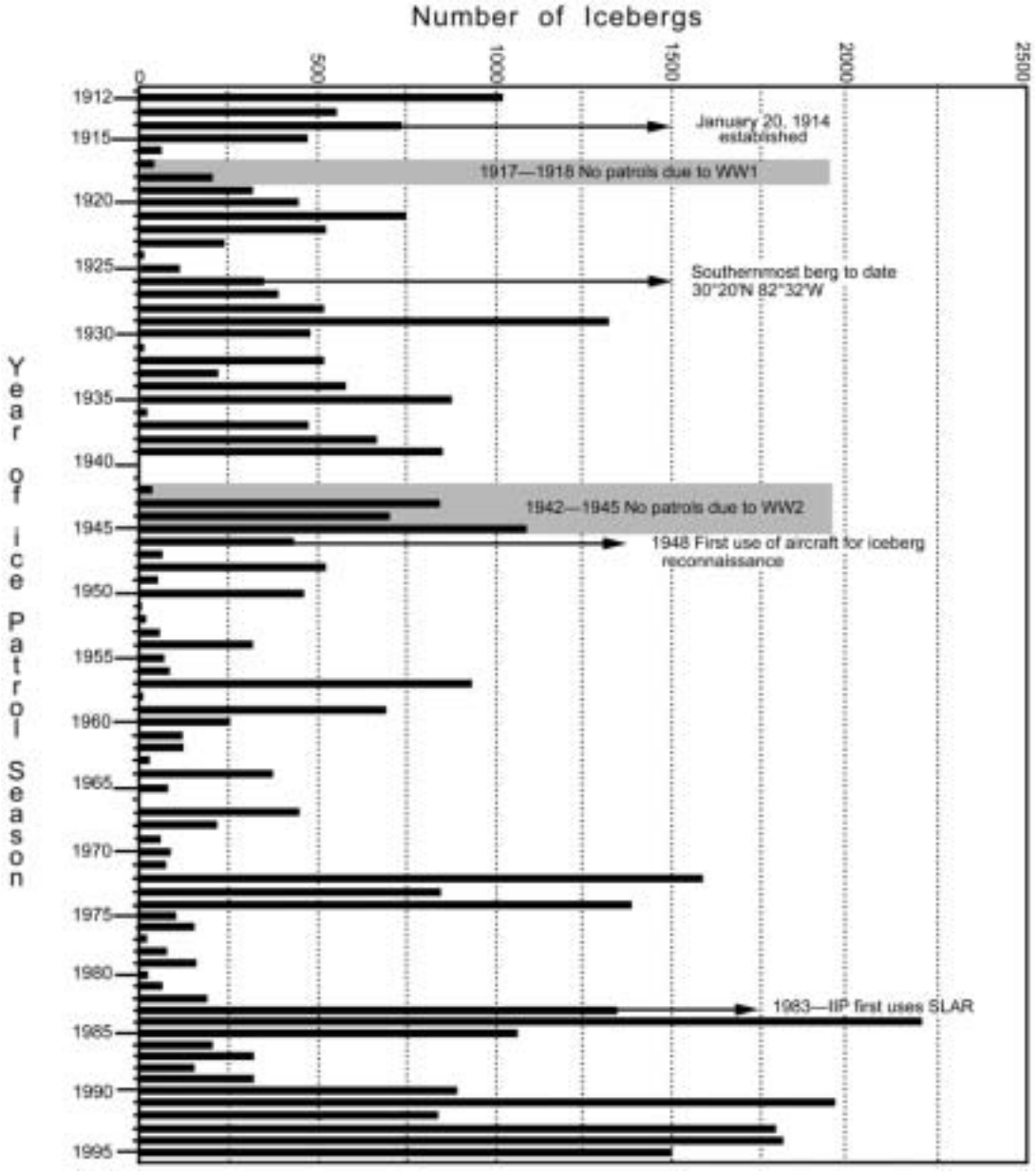
Shore-based aircraft and shipbased helicopters carry out regular ice reconnaissance throughout Arctic waters during the break-up to freeze-up period which is normally May to November. During winter months these trained ice observers, aided by remote sensing equipment, conduct monthly Arctic ice reconnaissance missions to monitor seasonal development.

Icebreaker Service

Masters are cautioned against attempting to save time by forcing a passage under full power through ice-congested areas unless the ice is in an obviously deteriorated condition. The indiscriminate use of full power in ice can inflict extensive damage to a vessel's underwater shell and fittings.

Whenever conditions warrant, icebreaker escort or assistance will be provided. However, vessels disregarding routing advice or failing to advise the Ice Operations Office of their presence in the area will have low priority for icebreaker assistance if beset, unless safety of life is involved.

As the Canadian Coast Guard has only a limited number of icebreakers available for the escort and support of shipping, they cannot always be provided when requested. It is therefore important for the Arctic Canada System (NORDREG CANADA) to be fully informed as to the whereabouts and movement of ships when ice is present. Failure to follow the proper reporting procedures, by ships unable to cope with



Annual Counts of Icebergs Crossing 48˚N Latitude (1912-95)

prevailing ice conditions on their own, will add to the difficulties of providing icebreakers and can lead to serious delays.

International Ice Patrol

International Ice Patrol (IIP) provides a service which monitors the extent of the iceberg danger in the vicinity of the Grand Banks of Newfoundland. This danger area is passed to interested shipping as a broadcast Limit of All Known Ice (LAKI). In order to define this limit as accurately as possible, IIP uses reports from various sources. These include icebergs detected by IIP and Canadian aircraft reconnaissance and reports from passing vessels. The path of reported icebergs since sighting is predicted using the momentum balance for each target and the deterioration of each iceberg is estimated using wave and sea surface temperature analyses from U.S. Navy models. The IIP watchstanders attempt to correlate new sightings with prior observations through the process of resights.

Ice Advisories and Forecasts

The Arctic Canada Traffic System (NORDREG CANADA) Center at Iqaluit, North West Territory (NWT) is staffed with an Ice Operations Officer during the Arctic navigation season. This office provides current information on ice conditions, advice on the best routes to follow, icebreaker support where

available and considered necessary, and the organization of convoys if required. The address for this center is:

NORDREG CANADA
Canadian Coast Guard
Department of Transport
P.O. Box 718
Iqaluit, N.W.T. XOA OH0
Telephone: (819) 979-5724
Facsimile: (819) 979-4236
Radiogram: NORDREG CANADA

The daily production of ice forecasts is the responsibility of Ice Central in Ottawa. The ice forecasting program coordinates the data recorded during aircraft reconnaissance flights with satellite imagery. These and other inputs are received to develop composite charts of current ice conditions. From these charts and predicted meteorological parameters, plain language ice forecasts are prepared and disseminated. Information for longer term planning, extended period ice forecasts and ice consultation services are available from Ice Control in Ottawa. The address for this office is:

Ice Central, Environment Canada, Lasalle Academy
373 Sussex Drive
Block "E," Third Floor
Ottawa, Ontario, KlA OH3
Telephone: (613) 996-5236
Telex: 0533761
Fax: (613) 563-8480

The plain language ice forecasts referred to above are broadcast by Canadian Coast Guard Radio Stations. For details of stations broadcasting these reports, broadcast times, frequencies used, and times of transmissions, consult the Canadian Coast Guard publications Radio Aids for Marine Navigation (Atlantic and Great Lakes) for the E part of the Arctic and Radio Aids for Marine Navigation (Pacific) for the W part of the Arctic.

Radio facsimile broadcasts of ice charts are sent by Station VFF Iqaluit for the E part of the Arctic, Hudson Strait, and Labrador. Station VFR Resolute sends charts for the central and W parts of the Arctic. For further details, see Pub. 117, Radio Navigational Aids.

In distress, transmit the International Distress Call on 2182 kHz and/or 156.8 MHz (VHF channel 16). If transmission on these frequencies is impossible, any other available frequency on which to draw attention should be used. Any Coast Guard Radio Station or vessel that hears a distress message will respond to inform the relevant RCC.

The transmission of a distress message may start an extensive sea and air search which sometimes continues for days in hazardous weather. Therefore, in need of urgent assistance but not in distress, vessels transmit the urgency signal on the frequencies described above. For further details concerning distress and urgency communications consult Pub. 117, Radio Navigational Aids.

Languages

The official languages are English and French.

Magnetic Field

Magnetic Variation and Local Anomalies

Most of the waters described in this publication are less than 1,000 miles from the North Magnetic Pole which, in 2000, was situated in the Arctic Ocean NNW of Ellef Ringnes Island; it is continuing to migrate NNW. Within this distance the magnetic compass not only becomes progressively more sluggish and less reliable for navigation; but, in many areas, like Hudson Bay, the magnetic variation also changes rapidly.

These adverse conditions may be accentuated by local magnetic anomalies which have been observed from time to time in a number of places off the W coast of Greenland, in Hudson Strait and Hudson Bay, the NW corner of Foxe Basin, the NW part of Baffin Bay, the E part of Parry Channel and in Admiralty Inlet, in Amundsen Gulf and in Coronation Gulf.

Magnetic fields in the Canadian Arctic are few and locations are uncertain. The isogonic curves close-in to merge and change measurements rapidly within short distances. As a result, charted variations in the Arctic are unreliable.

Magnetic storms are another source that cause compass error in the Arctic. Magnetic variation fluctuates constantly within the hour. Diurnal changes of 10˚ in variations have been observed.

The influence of frictional error is another directive force that cause the compass to dip. The frequency of combined disturbances decrease efficiency greatly, and become sluggish and unreliable. For this reason the compass performs better in a smooth sea free from ice than in an ice-infested area where its equilibrium is frequently offset by the vessel's impact on ice.

Magnetic storms are often accompanied by the dawn of Aurora Borealis, cause fleeting disturbances. Magnetic storms affect the magnetism of a ship as well as that of the earth. Changes in deviation as much as 45˚ have been reported during severe magnetic storms, possibly a total error.

Local magnetic disturbances occur when a mass of magnetic ore, possibly a wreck that lies sufficiently close to, cause compass error. This error is seldom caused by visible land, but more often by the ship passing over such masses of magnetic ore lying in shallow waters. It occurs in certain known localities, usually noted on the charts. Whenever a ship passes over an area of local magnetic disturbance, the position should be fixed, and the facts reported as far as they can be ascertained.

Navigational Information

Radiobeacons

In the N part of Hudson Bay and in Hudson Strait, there are several continuously operating marine or dual-purpose marine/air radiobeacons. For details see Pub. 117, Radio Navigational Aids. In addition, in the Canadian Arctic there are a number of aeronautical radiobeacons. The dual-purpose marine/air radiobeacons operate in the 200 to 405 kHz band. They transmit a continuous carrier which is modulated by a 1020 or 400 Hertz tone. This tone is interrupted six times a minute for the transmission of a one, two or three letter identifier.

North Warning System Beacons (NWSB) have been established for the Department of National Defence use and may be used by the public when available, if necessary for safe navigation. The beacons are uncertified and unmonitored. The

beacons are radio activated on 131.15 MHz, and provide approximately 20 minutes of service, operating at 125 watts power output.

Diving Operations

The "Diver down" flag (red, with a diagonal white stripe from the top of the hoist to the bottom of the fly) is commonly used on floats, buoys, and by small vessels to indicate an area where scuba diving or other diving activity is in progress. Other vessels should pass well clear of such areas and at a slow speed. This flag is not a substitute for the Flag A required to be displayed by vessels engaged in diving operations by Rule 27(e) of the 72 COLREGS.

Hydrographic Charts

Attention is drawn to the Canadian charts and publications regulations, an abbreviated description of which is given in the Annual Summary of Admiralty Notices to Mariners. Many of the present Canadian Arctic charts are based on aerial photography. There also are some charts where discrepancies of appreciable magnitude exists, such as in the charted positions of islands in relation to the adjacent coast, and in distances between coastlines forming channels. In some places, prominent topographic detail such as hills, mountains, and glaciers are incomplete or lacking. Soundings on some charts are compiled from vessels track and depth recorder, except where harbors and landing places have been systematically sounded. These depths have often been obtained with difficulty. Although the depths obtained by vessels enroute are accurate while navigating through ice, their positions may not be.

Most of Canada's Arctic waters have not been surveyed to modern standards, except for Lancaster Sound, Barrow Strait, the Beaufort Sea, Amundsen Gulf, and the approaches to settlements and some mining sites. Spot soundings through the ice or reconnaissance track soundings are the only survey data available in the Arctic. In the Beaufort Sea, a route through the area with a large number of pingos has been surveyed in greater detail.

Offshore Drilling

Offshore Exploration

Oil, gas and mineral drilling and production rigs, whether permanent or temporary, fixed or floating, may be encountered in increasing numbers in Canadian Arctic and adjacent waters.

Regulations

The regulations listed below are constantly being revised by the Canadians:

1. Shipping Safety Control Zones Order.
2. Arctic Shipping Pollution Prevention Regulations.
3. Arctic Waters Pollution Prevention Regulations.
4. Civil Liability Convention.
5. Pollution Regulations.
6. Ocean Dumping Control Regulations.
7. Pollutant Discharge Reporting Regulations.
8. Shipping Casualties Reporting Regulations.
9. Collision Regulations.
10. Charts and Publications Regulations.
11. Aids to Navigation Protection Regulations.
12. Quarantine Reporting Requirements.
13. Customs Reporting Requirements.
14. International Convention for the Protection of Submarine Cables.

Mariners are advised to make the necessary arrangements to obtain the complete and latest regulations governing subjects of interest. Copies of Canadian Government regulations are available by mail from the Canada Communications Group Publishing, Supply and Services Canada, Ottawa, Ontario KIA 0S9, Canada.

Advance Notice of Arrival

A 96-hour advance notice of arrival is required for the following vessels:

1. Vessels of 500 gross tons and over.
2. Vessels engaged in towing or pushing another vessel, when the combined tonnage of the vessel and the vessel being towed or pushed is 500 gross tons and over.
3. Vessels carrying polluting or dangerous cargo, or are engaged in towing or pushing a vessel carrying polluting or dangerous cargo.

Vessels must request clearance 96 hours prior to entering Canadian waters from seaward. If the time of arrival of the vessel in Canadian waters is less than 96 hours after the vessel departed its last port of call, the advance notice should be sent as soon as practicable.

Contact details can be found in the Appendix under ECAREG CANADA and NORDREG CANADA.

Conservation of Marine Mammals

The Federal Department of Fisheries and Oceans ensures the protection and conservation of marine mammals in Canadian waters. Harassing whales changes or interferes with their behavior, forces them away from their habitat at critical times in their annual reproduction and feeding cycles, and may cause them injury.

The Marine Mammal Regulations of the Fisheries Act (R.S.C., 1985, c.F.-14. Amended 1993) prohibit any form of harassment of cetaceans, including repeated attempts to pursue, disperse, or herd whales and any repeated intentional act of negligence resulting in disruption of their normal behavior. Individuals who contravene the Marine Mammal Regulations are guilty of an offense and liable to a fine not exceeding $500,000 and twenty four (24) months imprisonment (Fisheries Act sec. 78).

The following are general guidelines for dealing with marine mammals:

1. Do not hunt, chase, follow, disperse, drive, herd, or encircle whales.
2. Avoid any sudden changes of course or speed.
3. Avoid heading directly toward a whale.
4. If in an area known to be frequented by whales, be on the lookout to avoid collisions.
5. Travel parallel to whales' direction of travel.
6. The whales may come close to you; if they do, do not chase them. These animals may be calves that approach while their mothers are submerged feeding. Keep clear of the tail.
7. If you are operating a sailing vessel with an auxiliary motor, leave it in idle or turn on the echo sounder to signal your presence.

8. If it is impossible to detour around a whale or group of whales, slow down immediately and wait until you are more than 400m away before resuming speed.

Search and Rescue

The Canadian Armed Forces are responsible for coordinating all Search and Rescue (SAR) activities in Canada, including Canadian waters and the high seas off the coasts of Canada. Rescue Coordination Centers (RCCs) are situated in the Canadian Forces bases at Halifax, N.S.; Trenton, Ontario; Edmonton, Altberta; and Victoria, B.C. to coordinate activities in their regions. Each RCC is the headquarters of a coordinated network of agencies trained and responsible to search for and aid vessels in distress. There are Canadian Coast Guard Officers at each RCC, except Edmonton, who are on continuous watch to arrange the response to marine SAR incidents.

Marine Rescue Sub-Centers (MRCs) are maintained at St. John's, Newfoundland and Quebec City. These centers function as sub-centers of the above-mentioned RCCs. The MRCs at St. John's will coordinate the necessary response measures during marine SAR incidents in the waters off the coasts of Newfoundland and Labrador. The MRCs at Quebec will similarly respond to SAR incidents in the waters off the province of Quebec.

All distress situations and requests for assistance should be directed to the appropriate MRCs or RCC via the nearest Canadian Coast Guard Radio Station, Vessel Traffic System Center, or by any other available means.

All Canadian government ships and aircraft are available for search and rescue duties when required, as are all Canadian registered ships in accordance with the Canada Shipping Act.

In addition, the Canadian Coast Guard operates a number of specialized vessels whose prime mission is search and rescue.

Tides

The character and range of the tide vary greatly over the area covered by this publication. In general, it can be said that the theoretical semi-diurnal tide at the North Pole is zero; from this it can be expected that the range of the tide decreases as latitude increases.

This is largely true except that, in Kane Basin (79˚30'N., 70˚00'W.), the mean spring range reaches maximum of about 3.5m; to the N of this, however, the range decreases rapidly. Elsewhere on the W coast of Greenland, the tide is mainly semi-diurnal, the mean spring range being between 2 and 3m.

The greatest ranges are found in Ungava Bay, at the head of which the mean spring range is nearly 12m. In Hudson Strait the range varies between about 4 and 9m; in Hudson Bay it is between 2 and 4m, and in Foxe Channel it is about 5.5m. In all these areas the character of the tide is predominantly semi-diurnal. Farther N, in the Canadian Arctic Archipelago, the diurnal tide becomes more apparent, although it never completely predominates; in these areas the range decreases and seldom exceeds 1.5m. To the W of Boothia Peninsula and Prince of Wales Island it is less than 1m.

Tidal currents in the area vary considerably, depending on local conditions; details are given in the appropriate places in the text.

Time Zone

The Canadian Arctic is covered by multiple Time Zones. Information is given in the accompanying table.

World Time Zone Chart
http://www.odci.gov/cia/publications/factbook/ref/pdf/802801.pdf

Canada—Time Zones

Location	Standard Time	Daylight Savings Time
East coast of Baffin Island	QUEBEC (+4)	Not observed.
Eastern Northwest Territories	ROMEO (+5)	QUEBEC (+4) Observed from the first Sunday in April until the Saturday before the last Sunday in October.
Nunavet	ROMEO (+5)	Not observed.
Central Northwest Territories	SIERRA (+6)	ROMEO (+5) Observed from the first Sunday in April until the Saturday before the last Sunday in October.
Western Northwest Territories	TANGO (+7)	SIERRA (+6) Observed from the first Sunday in April until the Saturday before the last Sunday in October.
Yukon Territory	UNIFORM (+8)	TANGO (+7) Observed from the first Sunday in April until the Saturday before the last Sunday in October.

U.S. Embassy

Location:
490 Sussex Drive
Ottawa, Ontario
Canada, K1N 1G8

Mailing Address:
P.O. Box 5000
Ogdensburg, NY 13669-0430

Vessel Traffic Service

Eastern Canada Vessel Traffic Services Zone (ECAREG CANADA).—This is a mandatory system and includes Canadian waters on the E coast of Canada and Fishing Zone 1 (Gulf of St. Lawrence) as prescribed by the Fishing Zones of Canada (Zones 1, 2, and 3) Order:

(a) S of parallel of 60˚N.
(b) in the St. Lawrence River E of 66˚W.

It excludes the waters of Ungava Bay and the waters within the Vessel Traffic Services Zones for Halifax Harbour and Approaches, the Bay of Fundy and Approaches, Port aux Basques Harbour and Approaches, Placentia Bay and Approaches, St. John's Harbour and Approaches, the Strait of Canso and Approaches, and Northumberland Strait as defined in the Annual Edition, Canada Notices to Mariners

Arctic Waters Vessel Traffic Reporting System (NORDREG CANADA).—This is a voluntary reporting system operated by the Canadian Coast Guard. It applies to ships of 300 grt and above; ships carrying or towing dangerous or pollutants cargo; and ships and tows with a combined grt of 500 or above.

The object is to assist the mariner in the safe conduct of the vessel; to promulgate information on ice conditions; to advise on routes; and to provide ice-breaker support where available and considered necessary. The system applies in the Arctic Canada Traffic Zone, territorial sea, internal waters, fishing zones of Canada N of 60˚N, including the waters of Hudson Bay, James Bay, Ungava Bay that lie S of this parallel but excluding Mackenzie Bay and Kugmallit Bay S of 70˚N and E of 139˚W.

Note.—See Appendix for further information on ECAREG CANADA and NORDREG CANADA.

Appendix

EXCERPTS FROM CANADA NOTICE NO. 26

The following excerpts from Canada Annual Notice No. 26 contain information regarding reporting requirements and other information concerning ECAREG CANADA and NORDREG CANADA.

1. Introduction

1.1 The purpose of this is to describe the ship reporting procedures to be followed by vessels when:

(a) within or intending to enter the waters of Eastern Canada or Arctic Canada not contained within a local Vessel Traffic Services Zone.

(b) intending to enter the waters of Western Canada.

Note.—Information regarding entering the waters of Western Canada may be found in Pub. 120, Sailing Directions (Enroute) Pacific Ocean and Southeast Asia.

1.2 Ice information, ice routing, and icebreaker assistance may be obtained through the Eastern Canada Traffic System (ECAREG CANADA) and the Arctic Canada Traffic System (NORDREG CANADA).

Refer to the Annual Edition, Notice to Mariners and the publication "Ice Navigation in Canadian Waters."

1.3 An amendment to the Vessel Traffic Services Zone Regulations requires a report from vessels of 500 grt or greater, 24 hours prior to entering a VTS Zone. Reporting requirements shall be as specified in section 7.1.1 for Eastern Canada.

2. Zone description

The coastal and offshore waters of Canada have been subdivided into three distinct zones, each with their own telegraphic identifier. These zones are Eastern Canada VTS (ECAREG), Arctic Waters VTS (NORDREG), and Cooperative VTS (CVTS Offshore) on the W coast of Canada.

2.1 **Eastern Canada**

Eastern Canada Vessel Traffic Services Zone is a mandatory system and includes Canadian waters on the E coast of Canada and Fishing Zone 1 (Gulf of St. Lawrence) as prescribed by the Fishing Zones of Canada (Zones 1, 2 and 3) Order:

(a) S of parallel of 60˚N.

(b) in the St. Lawrence River E of 66˚W.

It excludes the waters of Ungava Bay and the waters within the Vessel Traffic Services Zones for Halifax Harbour and Approaches, the Bay of Fundy and Approaches, Port aux Basques Harbour and Approaches, Placentia Bay and Approaches, St. John's Harbour and Approaches, the Strait of Canso and Approaches, and Northumberland Strait as defined in the Annual Edition, Canada Notices to Mariners

Telegraphic Identifier—ECAREG CANADA
Facsimile—(902) 426-4483 or (709) 772-5369
Telex—019-22510 or 016-4530

2.2 **Arctic Canada**

Arctic Canada Traffic Zone includes those waters of Ungava Bay, Hudson Bay and James Bay south of the parallel of 60 north latitude and the waters to which the Arctic Waters Pollution Prevention Act apply.

It excludes MacKenzie Bay and Kugmallit Bay south of the parallel of 70˚ north latitude and east of the meridian of 139 west longitude.

Telegraphic Identifier—NORDREG CANADA
Facsimile—(867) 979-4236 or (867) 979-4264
Telephone—(867) 979-5724 or (867) 979-5269
Telex—063-15529

2.3 **Western Canada**

See Pub. 120, Sailing Directions (Enroute) Pacific Ocean and Southeast Asia for further information.

3. Application

3.1 **ECAREG**

With respect to the Eastern Canada VTS Zone, the Eastern Canada Vessel Traffic Services Zone Regulations apply to every ship of 500 grt or more. Participation is mandatory.

3.2 **NORDREG**

With respect to the Arctic Canada Traffic Zone the provisions of this notice apply to every ship of 300 tons, gross tonnage, or more. Participation is voluntary; however, mariners are encouraged to participate fully to receive the maximum benefit.

3.3 **Western Canada**

See Pub. 120, Sailing Directions (Enroute) Pacific Ocean and Southeast Asia for further information.

3.4 **All zones**

In addition, the provisions of this notice apply (on a mandatory or voluntary basis, as applicable) to all other ships meeting the following criteria:

(a) every ship that is engaged in towing or pushing one or more vessels, where the combined tonnage of that ship and its tow amounts to 500 grt or more.

(b) every ship carrying a pollutant or dangerous goods, or engaged in towing or pushing a vessel carrying a pollutant or dangerous goods as prescribed in the following:

i. Oil Pollution Prevention Regulations;
ii. Pollutant Substances Regulations;
iii. Dangerous Goods Shipping Regulations;
iv. International Maritime Dangerous Goods Code (IMDG); and
v. Dangerous Chemicals and Noxious Liquid Substances Regulations.

4. Responsibility

4.1 There is no intention on the part of the Canadian Coast Guard to attempt to navigate or maneuver ships from a

shore station and nothing in this Notice overrides the authority of the master for the safe navigation of his ship. Information passed to the master is intended to assist him in the safe conduct of his ship.

4.2 The master shall supply all information that is required of him by this notice. A Marine Traffic Regulator may under specific circumstances issue a direction to a ship.

4.3 Notwithstanding section 4.2, the master, pilot or person in charge of the deck watch may take any action that may be required to ensure the safety of the ship or any other ship.

4.4 When the required communications cannot be conducted owing to radio difficulties, a ship may continue with its voyage and the master shall take all reasonable measures to report the occurrence to a Marine Traffic Regulator as soon as possible and shall proceed to the nearest safe port or anchorage on his route where the radio equipment can be repaired.

5. Traffic clearance

5.1 A "traffic clearance" is an authorization for a ship to proceed subject to such conditions as may be included in the authorization. A traffic clearance does not eliminate the need for other authorizations required by legislation or by-laws.

5.2 A traffic clearance is required before:

1. entering a traffic zone (see 1.3 and 7.1 or 8.1 as appropriate).
2. departing a berth (see 7.3 or 8.3 as appropriate).
3. proceeding after being stranded, stopped due to breakdown of main propulsion machinery or steering gear, or having been involved in a collision (see 6.4.1).

5.3 A traffic clearance may be obtained by providing the appropriate report in accordance with procedures specified in the appropriate sections.

6. Reports

6.1 **General**

All times given in reports required by this notice shall be Coordinated Universal Time (UTC).

A report shall use the appropriate telegraphic identifier and be communicated to the nearest Canadian Coast Guard MCTS Center.

The master of a ship shall ensure that reports are made in accordance with the stated requirements.

6.2 **Information required**

The following information may be required in a report:

(a) the name of the ship.
(b) the radio call sign of the ship.
(c) the name of the master of the ship.
(d) the position of the ship.
(e) the time the ship arrived at the position.
(f) the course of the ship, if any.
(g) the speed of the ship, if any.
(h) the prevailing weather conditions (including ice, applicable).
(i) the estimated time that the ship will enter the Vessel Traffic Services Zone.
(j) the estimated time the ship will depart the berth.
(k) the destination of the ship.
(l) the ETA of the ship at the destination.
(m) the route the ship intends to take through the Vessel Traffic Services Zone to arrive at the destination.
(n) the name of the last port of call of the ship.
(o) the draft of the ship.
(p) any dangerous goods, listed by class, or pollutant, that is carried on board the ship or vessel being towed or pushed by the ship.
(q) revoked.
(r) any defect in the ship's hull, main propulsion machinery, steering system, radars, compasses, radio equipment, anchors or cables.
(s) any discharge, or threat of discharge, of a pollutant from the ship into the water, and any damage to the ship that may result in the discharge of a pollutant from the ship into the water.
(t) the name of the Canadian or United States agent of the ship.
(u) the date of expiration of a certificate referred to in Article VII of the International Convention on Civil Liability for Oil Pollution Damage, 1969; the International Oil Pollution Prevention Certificate; the International Pollution Prevention Certificate for the Carraige of Noxious Liquid Substances in Bulk; the Certificate of Fitness; and the Certificate of Compliance, if any, issued to the ship.

6.3 **Routine reports**

Procedures for providing routine reports are described in the appropriate zone procedures in section 7 (ECAREG) and section 8 (NORDREG).

6.4 **Non-routine reports**

6.4.1 **Stranding, Propulsion or Steering Failure, and Collision**

When a ship is within the Eastern Canada VTS Zone or Arctic Canada Traffic Zone, a report is required immediately before a ship proceeds underway after being stranded, or having had a propulsion or steering gear failure, or having been involved in a collision. The following information shall be provided:

(a) name of ship.
(b) position of ship.
(c) description of the incident.

6.4.2 **Other occurrences**

Any of the following conditions should be immediately reported when the ship is within or about to enter a zone:

(a) the occurrence on board the ship of any fire.
(b) the involvement of the ship in a collision, grounding, or striking.
(c) any defect in the ship's hull, main propulsion systems, steering systems, radars, compasses, radio equipment, anchors, or cables.
(d) another ship in apparent difficulty.
(e) any obstruction to navigation.

(f) any aid to navigation that is functioning improperly, damaged, off-position, or missing.

(g) any ice and weather conditions that are detrimental to safe navigation.

(h) the presence of any pollutant in the water.

Note.—Items (e), (f), and (h) are not required if the information has been previously promulgated by a Notice to Shipping.

Mariners are encouraged to provide, on a voluntary basis, any information pertaining to charts and publications which may not be on board so that arrangements can be made to embark the necessary items.

6.4.3 **Change in information**

A report shall be made whenever a significant change occurs in the information contained in any report made pursuant to this Notice, except in the case of reports 7.4 and 8.5.

7. ECAREG—Routine reports

7.1 **Entering the zone**

7.1.1 A report containing the information listed in 6.2, except item (j), shall be made 24 hours prior to entering the zone, or as soon as practicable where the estimated time of arrival of the ship at the zone is less than 24 hours after the time the ship departed from the last port of call.

Note.—This report is not required in a case where:

(a) the ship is on a voyage between two ports within the zone, and

(b) the ship is entering the zone directly from the Arctic Canada Traffic Zone, and is in possession of a valid NORDREG Clearance.

7.1.2 A report containing the information listed in 6.2(a), (b), (d), (h), and (i), shall be made immediately before the ship crosses the zone boundary when entering the zone. This report is not required when entering directly from a local VTS zone.

7.2 **Arriving at a berth**

A report shall be made on arrival of the ship at the berth, containing the information listed in 6.2(a), (b), and (j) as well as the following information:

(a) port of arrival.

(b) time of arrival.

7.3 **Departing a berth**

This report is not required where the ship is proceeding to another berth in the same port.

A report containing the information listed in 6.2, except item (i), shall be made 2 hours before a ship departs a berth.

A traffic clearance to depart a berth is valid for 1 hour from estimated time of departure. Where a traffic clearance to depart a berth has expired because of a revised time of departure, a new traffic clearance is required. In this case, the report need only contain the ship's name, call sign, position and revised time of departure.

7.4 **Exiting the zone**

A report containing the information listed in 6.2(a), (b), (d), and (h) shall be made immediately before the ship crosses the seaward boundary.

In a case where exiting a zone coincides with entering a local VTS zone, this report is not required.

7.5 **Supplemental SAR information**

In addition to those reports required by the Eastern Canada Vessel Traffic Services Zone Regulations, Search and Rescue authorities have requested that ships entering Canadian waters for the first time answer the following question:

Is your vessel EPIRB equipped? If not, please supply the following information:

(a) number of crew and passengers.

(b) number of lifeboats and life rafts plus make and capacity.

(c) color of hull and superstructure.

(d) distinctive features.

This information need only be updated as necessary. The information will be maintained on a database and made available to Search and Rescue personnel when required.

8. NORDREG—Routine reports

8.1 **Entering the zone**

8.1.1 A report containing the information listed in 6.2, except item (j), but including the following information:

(a) ice class (type or Arctic class category), if applicable, and Classification Society;

(b) amount of oil on board (fuel and cargo), if such amount exceeds 453 cu. m. (15,988 cu. feet); and

(c) date of issue of Arctic Pollution Prevention Certificate, if carried and name of Classification Society;

shall be made 24 hours prior to entering the zone, or as soon as practical where the estimated time of arrival of the ship at the zone is less than 24 hours after the time the ship departed from the last port of call.

If the ship is entering the zone directly from the Eastern Canada Vessel Traffic Services Zone, and is in possession of a valid ECAREG Clearance, only items 8.1.1(a), (b), and (c) need be reported.

8.1.2 A report containing the information listed in 6.2(a), (b), and (d) shall be made immediately before the ship crosses the zone boundary when entering the zone.

8.2 **Arriving at a berth**

A report shall be made on arrival of the ship at the berth, containing the information listed in 6.2(a), (b), and (j) as well as the following information:

(a) port of arrival.

(b) time of arrival.

8.3 **Departing a berth**

8.3.1 This report is not required where the ship is proceeding to another berth in the same port.

8.3.2 A report containing the information listed in 6.2(a), (b), (h), (j), (k), (l),(m), (p), and 8.1.1(b), and any change to previously reported items 6.2), (s), (t), and (u), shall be made not more than 2 hours and not less than 1 hour before departing a berth.

8.3.3 If the estimated time of departure changes by more than 1 hour, a report shall be made containing the revised estimated time of departure.

8.3.4 A report shall be made when the ship has departed the berth, giving the actual time of departure.

8.4 **1600 UTC report**

A report containing the information listed in 6.2(a), (b), (d), and (h) shall be made daily at 1600 UTC.

8.5.1 **Ice Regime Routing Message**

When the Arctic Ice Regime Shipping System is used, the Arctic Shipping Pollution Prevention Regulations (ASPPR) require that an Ice Regime Routing Message be sent to NORDREG. This message can be brief; however, if the vessel's route includes areas on ice analysis charts with ice concentrations that may have negative Ice Numerals, the message should include additional pertinent information explaining the voyage plan (e.g., expectations of changes in conditions and/or other considerations). The message should be updated if the plan and/or ice conditions change significantly.

The Ice Regime Routing Message should include:

(a) ship name.
(b) ship call sign and IMO number.
(c) the ice stregthening of the ship (Type/CAC/Arctic class, etc.).
(d) date and UTC time.
(e) ship's current position, course, and speed.
(f) anticipated destination.
(g) intended route.
(h) a listing of the ice regimes and their associated Ice Numerals.
(i) source(s) of ice information.
(j) any other pertinent information or comments.
(k) name of any escorting vessel.
(l) name(s) of the Ice Navigator(s) on board.

8.5.2 **After Action Report**

When the Arctic Ice Regime Shipping System is used, in accordance with the ASPPR, an after action report is to be submitted. The report can be brief; however, in cases where the voyage has involved difficulties or unexpected occurrences, it will be valuable to include additional information. Unlike the routing message, the After Action Report is to be sent to Transport Canada, as follows:

Regional Director, Marine
Prairies & Northern Region—ANMS
Transport Canada, Place de Ville, Tower "C"
330 Sparks Street, 14th Floor
Ottawa, Ontario
K1A 0N5
(Facsimile: (613) 991-4818)

The After Action Reprt should include:

(a) ship name.
(b) the ice strengthening of the ship (Type/CAC/Arctic class, etc.).
(c) a description of the actual route, including transit speeds, the ice regimes encountered, and the Ice Numerals for each.
(d) copies of the ice information used.
(e) escort information, if applicable.
  (1) duration of the escort.
  (2) ice regime under escort
  (3) charactaristics of the track
(f) weather conditions and visibility.
(g) any other important information.

8.6 **Exiting the zone**

A report containing the information listed in 6.2(a), (b), (d) and (h), shall be made immediately before the ship crosses the seaward boundary.